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Polar Regions in Transformation - Climatic Change and Anthropogenic Pressures

BOOK OF ABSTRACTS

Edited by Frank Günther, Guido Grosse, and Benjamin Jones

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Coastal destruction in the western and eastern-most occurrence of tabular ground ice in the Eurasian Arctic

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Destruction of arctic permafrost coasts occurs as a result of a complex suite of processes, predominantly thermal abrasion and denudation. Activation of these processes can be particularly observed in case of massive ground ice bodies (ice wedges or tabular ground ice) that become exposed on high bluffs along the coastline. Tabular ground ice is a widespread geological feature on Arctic plains.

Thermo-denudation of exposed ground ice includes ice ablation, thaw of enclosed frozen deposits and the development of retrogressive thaw slumps with thermo-cirques or thermo-terraces formation. Due to its high self-enforcing process intensity thermo-denudation can be referred to as one of the most hazardous processes of permafrost degradation.

We are study the current coastal destruction dynamics in the western (Kolguev Island) and eastern-most (Novaya Sibir' Island) occurrence of tabular ground ice in the Eurasian Arctic.

With higher temporal resolution, studies on Kolguev Island continue earlier research efforts on coastal dynamics, while thaw slumps on Novaya Sibir' still require a quantitative assessment of their erosion dynamics. Coastal dynamics are analyzed using a whole set of multi-temporal satellite images of high and very-high spatial resolution (GeoEye, WorldView, Alos Prism, SPOT, Formosat, and Kompsat). For orthorectification purposes, the 12 m TanDEM-X DEM has been used. However, since the TanDEM-X DEM is based on averaged bistatic SAR surveys acquired during the period 2010 – 2012. This DEM can be used only for orthorectification of images newer than 2012 to determine the exact position of the coastal bluffs and thermocirque edges. We therefore reconstructed the relief along erosive coastline segments by modifying the initial TanDEM-X DEM through extrapolation of coastal bluffs edge elevation values and restoration of the coastal plain relief at 200 – 300 m towards the sea for orthorectification of images prior to 2012. All raw images were terrain-corrected and georeferenced using a comprehensive block adjustment, resulting in a very high absolute and relative accuracy of all images.

On western part of Kolguev Island coastal retreat rates during the 2002 – 2012 period varied from 1.7 to 2.4 m/year. Thermo-cirque growth averaged rates were 2.6 m/year, maximum 14.5 – 15.1 m/year. We are about to extend our observations to more recent high resolution acquisitions.

We are currently processing new data on the Novaya Sibir' Island, where tabular ground ice exposures occur in the northern part of the island in the Mira Bay. This study is carried out in the same way as on the Kolguev Island and will allow to detect commonalities and differences in two contrasting environmental settings with "warm" and very cold permafrost.

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